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DESIGN OF SIMULATION TECHNIQUES FOR DATA PREDICTION IN PUBLIC TRANSPORTATION

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ABSTRACT

One problem that Jakarta faces is, traffic jam. It's because, most of the people in Jakarta prefer using the personal vehicle. The main reason most of Jakarta citizens using the quality of service of public transportation are too low, for example, when the citizen wants to find take the Metromini bus as the public transportation, but later they did not know where this Metromini bus heading after also some bus stop area does not exist. There are two things that became the main problem of a passenger Metromini bus; the first is the route information that is not clear, and there is no convenient place for the bus stop and sometimes the Metromini bus can be not stopped at every station. The second is the price Metromini bus is charged same for all distances. Based on the situation, this study wants to provide the real time application to show the information about the bus transportation system in west Jakarta to passengers, which can help to decrease a number of waiting times. The variable that used to make this prediction is distance per bus stop and travel time, for speed decide to get them from input our users and the output is a prediction of arrival time in the bus stop and the detail of route information.

KEYWORDS: Public Transportation, Prediction, Simulation & Web Application

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Original Article

INTRODUCTION

Based on the government documentation in West Jakarta, the increase in the motor vehicle growth rate of 10%, this is one of the causes of traffic jam in Jakarta, therefore many citizens of Jakarta prefers to use their own vehicle than using public transportation in Jakarta. Also, one of the problems is the lack of public satisfaction with the existing public transport service in Jakarta and do not meet customer need. In the previous studies, Lin and Zeng (1999) developed arrival time estimation algorithms based on historical data, to provide real time information. The algorithms were developed with different assumption on input data, like schedule adherence, waiting time at-time-check stop, bus location data and schedule information. They developed the algorithms for buses in rural area, without considering the effect of traffic congestion and dwell time at the bus stop. Patnaik et al. (2004) built a regression model to calculate the arrival time of the bus, and also identify the problem that occurred during processing of data collected through APC (Automatic Passenger Counting) units. The independent variables used were distance between the stop, number of bus stops, number of passenger boarding and alighting, weather descriptor and dwell times.

In this study, a prediction time has been developed, that can dynamically calculate bus arrival times at bus stop, to create and calculate data flexibly, that we need to know and what the traffic condition is with the Metromini bus, in the public transportation area of west Jakarta. West Jakarta has high population, which indirectly use public transport system, which has high potential. The objective of this research is to study the

Metromini bus number 92 and 80, which is where Metromini 92 serves routes:"Ciledug to Grogol", and, Metromini 80 serves routes:"Kalideres to Jembatan Lima" as shown in the Figure 1. In order to make the time predictions, it requires data from the object, which include; the distance from each stop, the initial position of the bus, and of course the picture of the second route of the bus. At the end, data processing will be represented using Android Studio and PHP programming language. Later in the application, the setup and the prediction of arrival time can be seen.

Figure 1: Metromini Bus Routes

PROBLEM DEFINITION AND DEVELOPMENT

Data required in the prediction process and the observations were done on May 16 until 26 May 2016. The phase of this observation is to do validation of the data, which were gathered from Google maps. Three things that need to be validated are: validation of the bus route, record all the pass route to and also the availability of the bus stops are still worthy of use, such as having a roof and seating. After validation, these routes were chosen to develop the travel time prediction model, shown in Table 1. The data has been collected through observation for route no. 92. We attempted an observation on May 2016. The data that we collected was in the range per bus stop, the seventh bus arrival time at the first bus stop. For route map, maximum and minimum speed and parameters were collated using mobile apps called "Endomundo". Max and min speed is an important component, because we decide the category of speed depends on the max and min speed. From the observation, we declare min speed as 10km/h and max speed as 60km/h for both routes.

Table 1: Metromini Bus Routes 92 and 80

No.	Detail of Bus Route	Route No. 92	Route No. 80
1.	Travel time	80 – 120 minutes	60 – 100 minutes
2.	Number of bus stop	14	29

In this study, we have some assumptions to build the system that requires several assumptions that are used to facilitate the making of the system:

Speed

Speed used in the system is divided into 4 kinds of jams, solid, crowded smoothly and smoothly. Assuming if the jammed speed used is 10 km/hour, if solid 20 km/hour, if crowded smoothly 40 km/hour and if smoothly 60 km/hour. The maximum speed is only 60 km/hour, because Metromini bus has a maximum speed limit.

Starting Point

The initial position of the bus is assumed to be at stop 1, this research, takes 7 buses passing at the first stop, and 7 buses are referred to as starting point, why 7 buses is because of time limitations, and stop 1 is made starting point, because not all buses start from the bus station.

Variables

The independent variable, which exists in this research, is a step, which wants to predict by the user. It's just those applications that is made temporary and can only predict the stops that pass by mini metro 80 and 92. The dependent variable that exists in this research is the location between distance from stop 1 to another bus stop. And also, the speed has been classified into 4 parts, according to the assumption.

In this study, we divide speed into 4 categories: no traffic delay, where maximum speed applies (60km/h), medium traffic delay (40km/h), traffic delay (20km/h), traffic jam (10km/h). The speed above is inspired from Google Maps traffic volume layer. *TT = A+B*DISTANCE / Speed,* where A and B are bus stop.

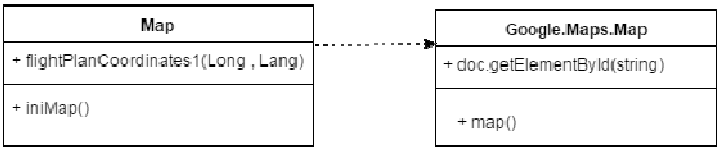

Figure 2: Class Diagram

The class diagram (Figure 2) shows the map appearance, function and the system load maps, as provided by Google, that were accessed through Google Maps. And, the variable used is to adjust the position of the map, shown in the form coordinate. In the route drafter function of the map, the variable used is the point of the coordinator used as the reference for the map, describing the route of a particular Metromini bus. And, the code for the public transport is used to set the focus of the route, if the user wants to see another route. The application was developed based on web application to make sure all citizens can access easily. By using this application, user can get information about the bus arrival times and the route map based on the real situation. Therefore, in this application user can input the speed of the traffic later the application can give the time prediction, when the bus will be arriving.

Figure 3: Result in the Application

In this Application Have Some Functions Like

- **Select a Map**

This function aims to determine which map will be loaded on the home page. This function contains details of the conditions in the form of value, and what user selected will be matching with the existing map?

- **Select Prediction**

This function aims to load the prediction of time, in accordance with user input conditions and then, if the condition would filter prediction results, according to user input.

- **Database Connector**

This function aims to connect the website to the database, and this function aims to retrieve data in the database to be displayed by the user.

- **Prediction**

This calculation function is done by adding a private start time declaration of the first bus estimation function, as well as other buses. After the estimation data of the seven buses is obtained, the estimation will be entered into the database separated by the stop and speed.

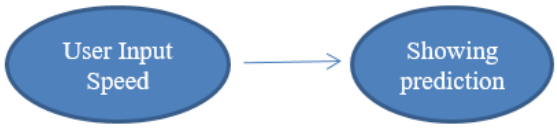

Figure 4: The Application Functions

RESULTS AND DISCSUSSIONS

The performance of the developed models was evaluated by applying two test; the first test is random testing at some bus stop with random time, so the scenario for this test will be, like user trying to use prediction at some bus stop, some people have been waiting at some bus stop that randomly generate. And, the result is show in the table below.

Table 2: Testing Result for Bus Routes No. 92 (a) Day 1, (b) Day 2, (c) Day 3

Number Bus Stop	Speed on Road	Bus Arrival Time	Arrival Time Prediction	Delay
3	40km/h	8:38:00	8:25:46	0:12:14
4	20km/h	9:19:00	9:49:45	0:30:45
7	60km/h	10:09:00	10:24:14	0:15:14
10	40km/h	11:37:00	11:33:08	0:03:52
11	60km/h	12:06:00	12:04:40	0:01:20
13	40km/h	12:23:00	12:27:04	0:04:04
14	20km/h	12:47:00	12:54:31	0:07:31
1	40km/h	14:58:00	15:00:36	0:02:36
5	40km/h	15:42:00	15:46:28	0:04:28
6	60km/h	15:53:00	15:52:56	0:00:04

(a)

Number Bus Stop	Speed on Road	Bus Arrival Time	Arrival Time Prediction	Delay
2	40km/h	7:19:00	7:16:27	0:02:33
6	40km/h	8:50:00	8:42:52	0:07:08
13	60km/h	10:43:00	10:39:40	0:03:20
10	20km/h	10:57:00	11:46:12	0:49:12
8	40km/h	11:24:00	11:24:20	0:00:20

2	40km/h	12:50:00	12:56:59	0:06:59
3	60km/h	13:33:00	13:33:54	0:00:54
4	60km/h	14:04:00	13:40:22	0:23:38
2	40km/h	14:35:00	14:26:31	0:08:29
9	20km/h	15:31:00	15:32:01	0:01:01

(b)

Number Bus Stop	Speed on Road	Bus Arrival Time	Arrival Time Prediction	Delay
13	40 km/h	10:37:00	10:40:46	0:03:46
9	20 km/h	11:45:00	11:53:04	0:08:04
11	60 km/h	12:14:00	12:05:56	0:08:04
10	20 km/h	12:26:00	12:26:37	0:00:37
12	60 km/h	13:29:00	13:25:24	0:03:36
2	10 km/h	14:07:00	14:42:53	0:35:53
7	60 km/h	14:28:00	14:25:16	0:02:44
7	60 km/h	14:58:00	14:43:10	0:14:50
2	40 km/h	15:22:00	15:21:45	0:00:15
9	20 km/h	16:55:00	16:34:51	0:20:09

(c)

Delay Come early

Table 3: Testing Result for Bus Routes No. 92 (a) Day 1, (b) Day 2, (c) Day 3

Number Bus Stop	Speed on Road	Bus Arrival Time	Arrival Time Prediction	Delay
5	40 km/h	8:33:00	8:26:29	0:06:31
12	20 km/h	9:02:00	9:00:37	0:01:23
14	60 km/h	10:11:00	10:13:40	0:02:40
27	40 km/h	12:31:00	12:26:50	0:04:10
25	60 km/h	12:53:00	12:56:23	0:03:23
29	40 km/h	13:57:00	13:55:37	0:01:23
17	20 km/h	14:54:00	14:46:35	0:07:25
8	40 km/h	15:51:00	16:00:00	0:09:00
5	40 km/h	16:31:00	16:31:56	0:00:56
11	60 km/h	17:26:00	17:17:39	0:08:21

(a)

Number Bus Stop	Speed on Road	Bus Arrival Time	Arrival Time Prediction	Delay
2	40 km/h	7:31:00	7:33:08	0:02:08
21	40 km/h	9:16:00	9:08:44	0:07:16
25	60 km/h	9:50:00	9:49:50	0:00:10
17	20 km/h	10:38:00	10:23:59	0:14:01
28	40 km/h	11:05:00	11:04:16	0:00:44
2	40 km/hh	12:44:00	12:48:32	0:04:32
18	60 km/h	12:55:00	12:44:38	0:10:22
7	60 km/h	13:58:00	13:59:56	0:01:56
27	40 km/h	14:22:00	14:22:32	0:00:32
2	20 km/h	16:43:00	16:39:54	0:03:06

(b)

Number Bus Stop	Speed on Road	Bus Arrival Time	Arrival Time Prediction	Delay
23	40 km/h	8:44:00	8:40:14	0:03:46
4	20 km/h	9:02:00	9:00:01	0:01:59
5	60 km/h	9:07:00	9:12:13	0:05:13
22	20 km/h	10:12:00	10:14:51	0:02:51
18	60 km/h	12:35:00	12:31:35	0:03:25
13	10 km/h	14:46:00	14:42:37	0:03:23
Table (b): Contd.,				
16	40 km/h	15:01:00	14:52:40	0:08:20
16	40 km/h	15:35:00	15:37:40	0:02:40
25	40 km/h	16:02:00	15:53:04	0:08:56
20	20 km/h	17:54:00	17:45:42	0:08:18

(c)

Delay Come early

Based on the result in Table 2-3, the performance is satisfied, even they missed up to 30 minutes for bus route number 92, and from bus routes number 80, delay from arrival time with prediction is 14 minutes. The prediction of clock-shaped time making is easier for users to understand, when the arrival of mini metro at certain shelters and the route map used are in accordance with the observation. With this application, user can wait at a bus stop with certain information about the route and also the arrival time.

CONCLUSIONS

In this study, a new model has been developed, that basically used a historical model time prediction, with an input for use. The performance of the model was already tested with a random condition in some of the bus stops for a three day in a random hour, and gives a good result. For further work, it is suggested that prediction model can be improved by combining with other prediction model. It's also to create other bus route number in Jakarta, so people can more aware of the public transportation.

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